

# Intelligent Agents

## Chapter 2

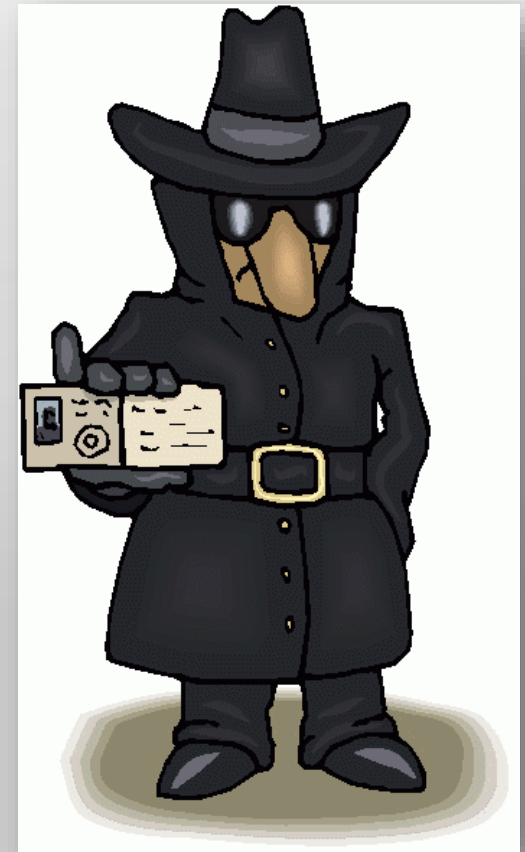


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# Lecture outline

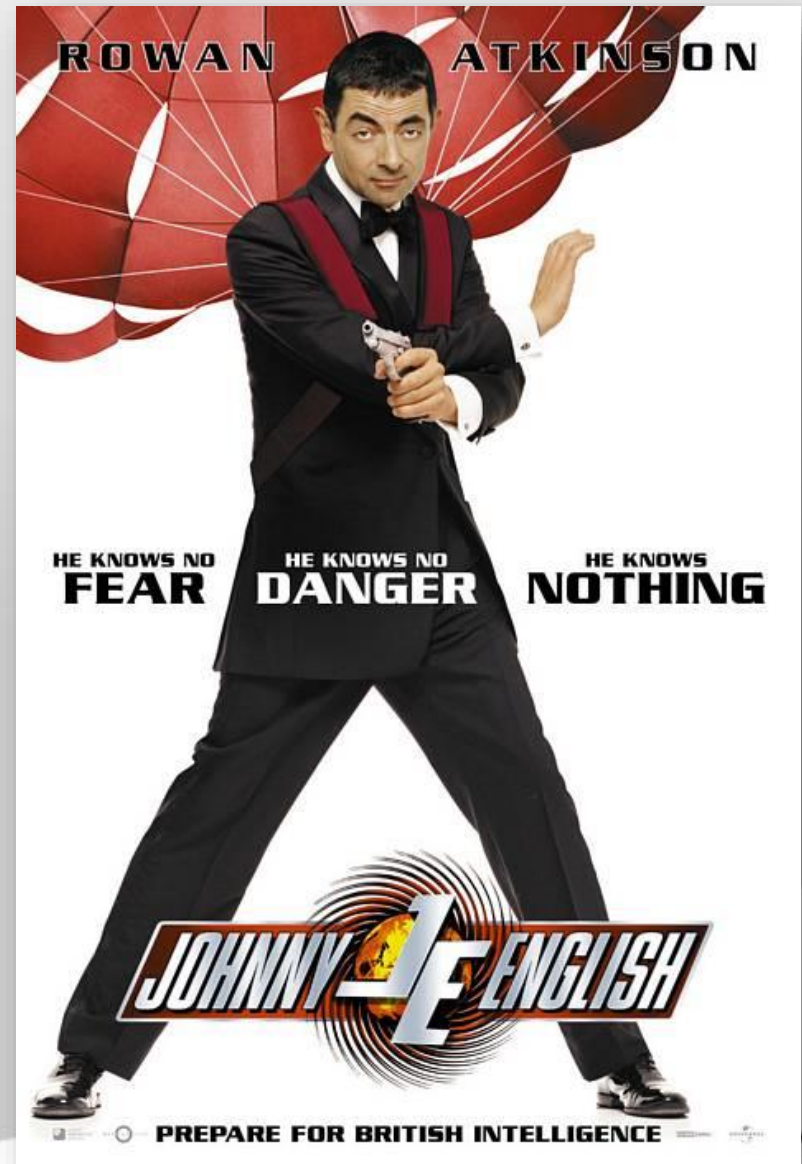
- Agents and environments
- Good behaviour: the concept of rationality
- The nature of environments





# Agents and environments

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators





# Agents and environments





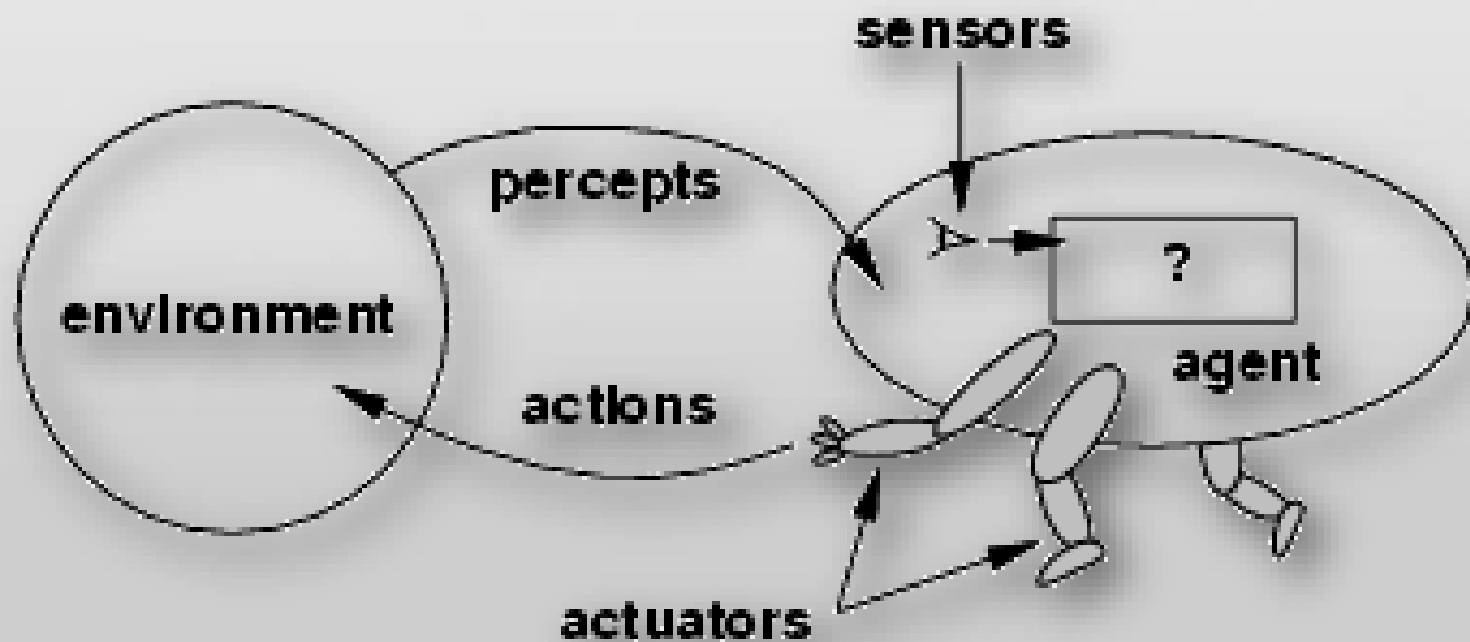
# Agents and environments







# Agents and environments





# Agents and environments

- Percept
- Percept sequence
- Agent's choice of action depends on possibly the whole percept sequence
- Agent function (external):  $[f: \mathcal{P}^* \rightarrow \mathcal{A}]$

Percept sequence	Action
...	...

- Agent program (internal)



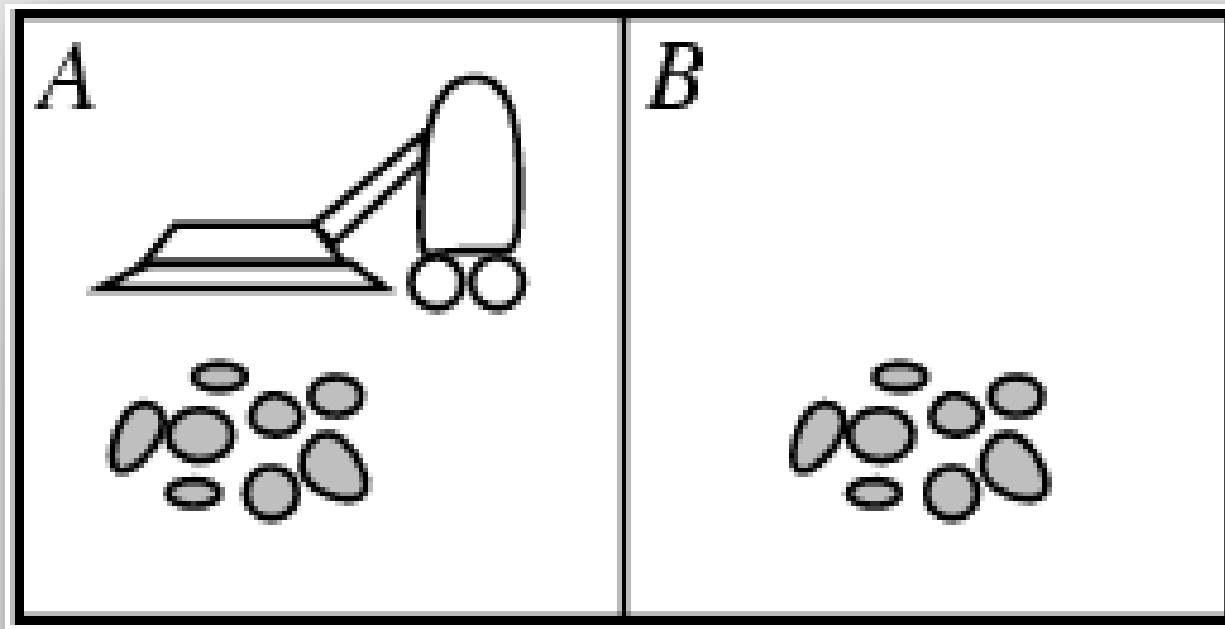
# Agents and environments







# Agents and environments





# Agents and environments

Percept sequence	Action
[A, clean]	Right
[A, dirty]	Suck
[B, clean]	Left
[B, dirty]	Suck
[A, clean], [A, clean]	Right
...	...
[A, clean], [A, clean], [A, clean]	Right
[A, clean], [A, clean], [A, dirty]	Suck
...	...



Table for agent function



# The concept of rationality

- A rational agent does the right thing!??
- The right action makes the agent the most successful (consequentialism)
- How do we measure success?
- Task that the agent must perform
  - Measure of success
  - Description of environment
  - Sensors
  - Actuators



# The concept of rationality

- Performance measure
  - Criterion of success of an agent's behaviour
  - An agent that acts in environment bring about states in environment
  - Need a criterion that is not subjective
  - Objective criterion created by designer of agent
  - Must be what is required in the environment
- Rationality depends on
  - Performance measure (success)
  - Agent's prior knowledge of the environment



# The concept of rationality

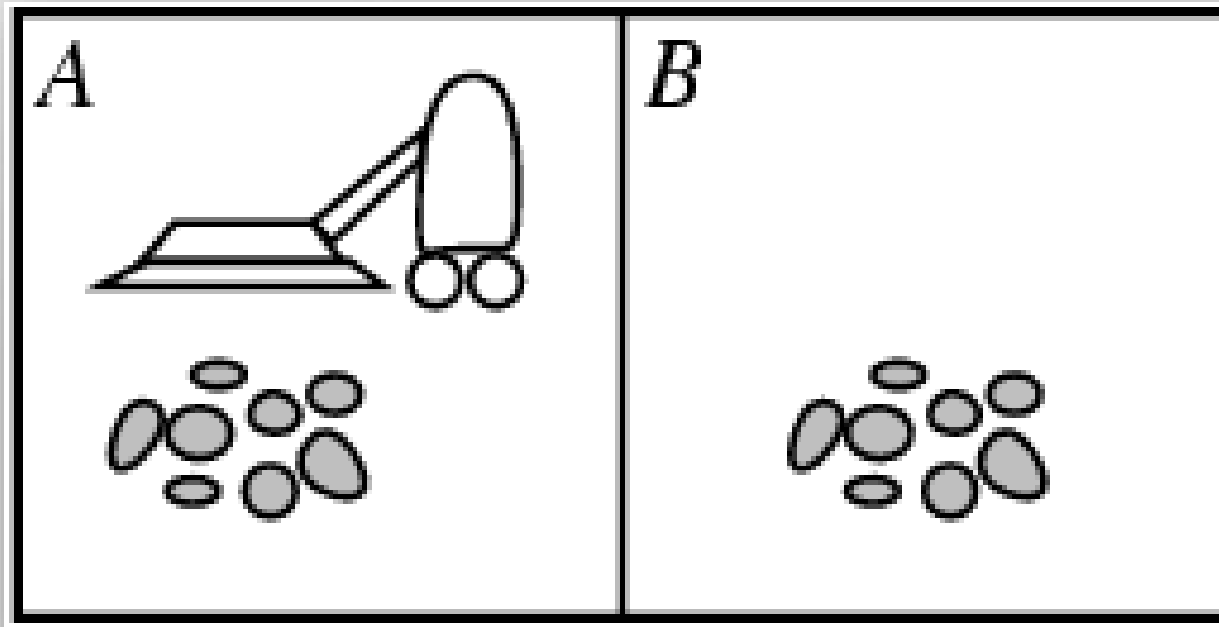
- Rationality depends on (continued)
  - Actions that the agent can perform
  - The agent's percept sequence up to date
- Definition of rational agent:
  - “For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.”





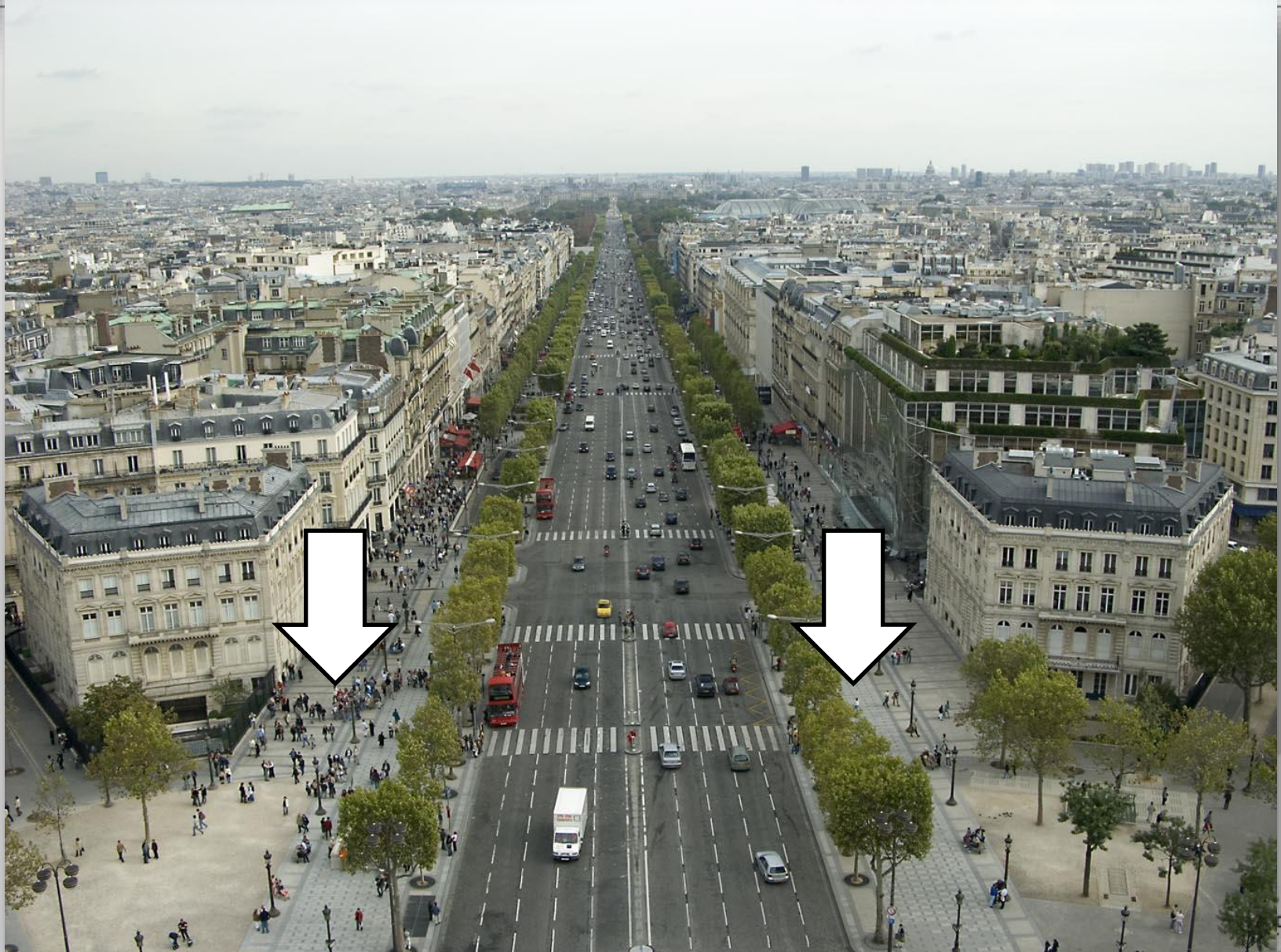
# The concept of rationality

A rational agent?





# The concept of rationality



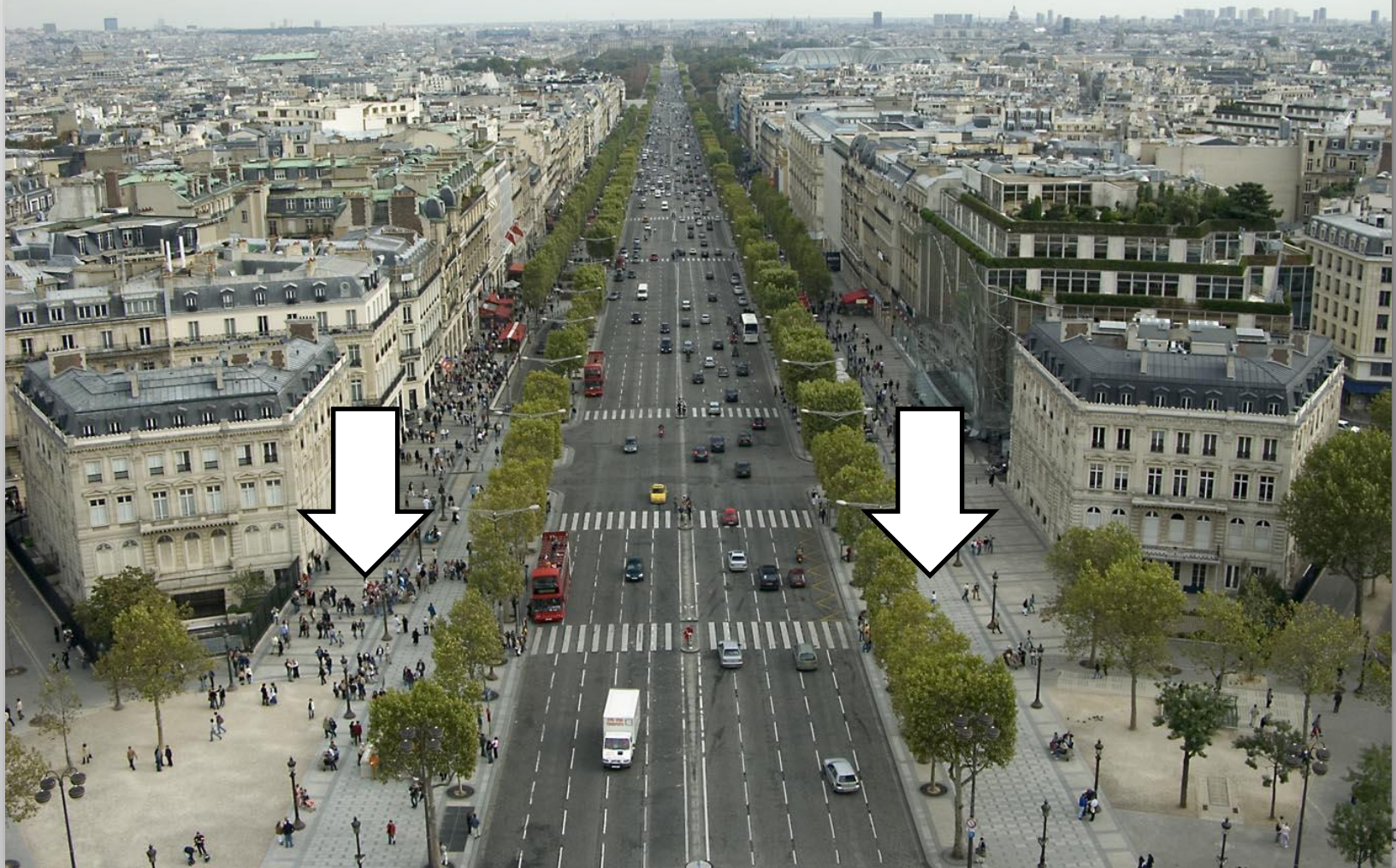




# The concept of rationality



33'000 feet





# The concept of rationality

- Omniscience versus rationality
- Rationality
  - Not equal to perfection
  - Does not require omniscience
  - Not busy with non-intelligent activities
- Rational agent gathers information and learn from observations
- Sometimes environment is fully known beforehand
- Example: dung beetle
- Some agents are not autonomous





# The nature of environments

- Before rational agent can be built, the task environment must be specified
- PEAS (Performance, Environment, Actuators, Sensors)





# The nature of environments





# The nature of environments

- Performance measure
  - Safe, fast, legal, comfortable trip, maximize profits
- Environment
  - Roads, other traffic, pedestrians, customers
- Actuators
  - Steering, accelerator, brake, signal, horn, display
- Sensors
  - Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard



# The nature of environments

- Examples of other agent types in Figure 2.5
- Real and artificial environments
- Software agents (softbots) exists
  - Flightsimulator
  - News stories
  - Internet





# Properties of task environments

- Classify task environments in terms of a number of dimensions
- Determine appropriate design and suitable implementation techniques of agents
- Later chapters consider specific statements and examples of each type of environment



# Types of environments

- Fully observable (versus partially observable)
  - Agent's sensors give it access to complete state of the environment at each point in time
- Deterministic (versus stochastic)
  - Next state of environment fully determined by current state and action performed by agent
  - If environment is deterministic except for actions of other agents, then the environment is strategic





# Types of environments

- Episodic (versus sequential)
  - Agent's experience is divided into atomic episodes
  - Each episode consists of agent perceiving and then performing a single action
  - The choice of action in each episode depends only on the episode
- Static (versus dynamic)
  - The environment stays unchanged while the agent operates
  - Semidynamic



# Types of environments

- Discrete (versus continuous)
  - A finite number of separate, explicitly defined percepts and actions
- Single agent (versus multi-agent)
  - A single agent operates in the environment
- Known (versus unknown)
  - Agent's state of knowledge about the “laws of physics” of the environment



# Types of environments

- The design of the agent is determined largely by the environment type
- The physical world is partially observable, stochastic, sequential, dynamic, continuous and multi-agent



# Types of environments

	Chess with a clock	Chess without a clock	Taxi driving
Observable	Yes	Yes	No
Deterministic	Strategic	Strategic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Single agent	No	No	No



# Assignment

- Study: Chapter 2.1 (Agents and Environments) - 2.3 (The Nature of Environments) of the ALMA e-book
- 18 March: Theory Quiz 2: Chapter 2.1 (Agents and Environments) - 2.3 (The Nature of Environments) of the ALMA e-book

